Particle shape enhances specificity of antibody-displaying nanoparticles.

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Public Summary:

Scientific Abstract:
Monoclonal antibodies are used in numerous therapeutic and diagnostic applications; however, their efficacy is contingent on specificity and avidity. Here, we show that presentation of antibodies on the surface of nonspherical particles enhances antibody specificity as well as avidity toward their targets. Using spherical, rod-, and disk-shaped polystyrene nano- and microparticles and trastuzumab as the targeting antibody, we studied specific and nonspecific uptake in three breast cancer cell lines: BT-474, SK-BR-3, and MDA-MB-231. Rods exhibited higher specific uptake and lower nonspecific uptake in all cells compared with spheres. This surprising interplay between particle shape and antibodies originates from the unique role of shape in determining binding and unbinding of particles to cell surface. In addition to exhibiting higher binding and internalization, trastuzumab-coated rods also exhibited greater inhibition of BT-474 breast cancer cell growth in vitro to a level that could not be attained by soluble forms of the antibody. The effect of trastuzumab-coated rods on cells was enhanced further by replacing polystyrene particles with pure chemotherapeutic drug nanoparticles of comparable dimensions made from camptothecin. Trastuzumab-coated camptothecin nanoparticles inhibited cell growth at a dose 1,000-fold lower than that required for comparable inhibition of growth using soluble trastuzumab and 10-fold lower than that using BSA-coated camptothecin. These results open unique opportunities for particulate forms of antibodies in therapeutics and diagnostics.

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